

Willingness and barriers to COVID-19 vaccination among Libyan adults: A cross-sectional survey

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Abstract: The success of COVID-19 vaccination programs depends on public acceptance, yet evidence from southern Libya remains limited. This study aimed to examine public perceptions, attitudes, and willingness toward COVID-19 vaccination among adults in urban and rural areas of southern Libya. A cross-sectional survey of adults in Sebha and the surrounding areas was conducted. Data were analysed using descriptive statistics and chi-square tests. A total of 785 questionnaires were distributed, of which 689 were completed and returned, yielding a response rate of 87.8%. The internet was the most commonly reported source of information about COVID-19 vaccination (58.2%), followed by television (25.4%). Overall, 64.6% of participants expressed willingness to receive the COVID-19 vaccine, while 35.4% were unwilling. Vaccine willingness was significantly associated with age group, marital status, place of residence, and education level. The most common reasons for acceptance were protection against COVID-19 infection (33.0%), free vaccine availability (20.0%), and prevention of transmission to others (15.8%). Among those who refused, the leading reason was concern about vaccine safety and/or side effects (50.0%), followed by preference to wait and observe effects in others (14.3%), doubts about effectiveness (10.3%), and general vaccine distrust (9.9%). Regarding opinions, 50.4% agreed that COVID-19 vaccination was important, 50.9% agreed that everyone should receive the vaccine once it is available, and 37.3% supported mandatory vaccination. This study reveals moderate willingness to receive COVID-19 vaccines among adults in southern Libya, with safety concerns and mistrust as key barriers. Targeted campaigns that engage healthcare professionals and counter misinformation are urgently needed. Importantly, these barriers extend beyond COVID-19, affecting routine and future vaccinations. Given Libya's fragile health system, these efforts must be integrated into a comprehensive national immunization plan to build sustainable vaccine confidence and resilience in the health system.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has affected every continent, with Africa being the last to report widespread transmission [1]. By early 2021, more than 108 million people across 150 countries had been infected, and the global consequences extended beyond health to include profound social and economic disruptions [2]. Developing countries, particularly those with fragile healthcare systems, have faced disproportionate burdens of morbidity, mortality, and socioeconomic impact. Vaccination has historically been

one of the most effective and reliable public health strategies, leading to significant reductions in mortality and morbidity from numerous infectious diseases [3, 4]. Vaccines are generally safer than many therapeutic agents, a fact supported by independent scientific evidence and global health authorities such as the World Health Organization (WHO) [5]. In the context of COVID-19, vaccines have been rapidly developed across multiple technological platforms and have demonstrated high levels of efficacy in clinical trials [6]. Nonetheless, vaccination programs depend not only on vaccine availability but also on community acceptance and uptake [7]. Despite their proven benefits, vaccine hesitancy remains a significant barrier. Concerns about side effects, safety, efficacy, and mistrust in health systems have contributed to reluctance across different populations [8-11]. Such hesitancy varies by demographic and geographic factors, with studies reporting lower vaccination rates among rural communities and minority groups compared to urban populations [12-14]. Rural residents may face additional challenges, including limited healthcare infrastructure and longer travel distances to vaccination sites, which can further reduce uptake [15].

In Libya, the Ministry of Health launched a vaccination program in 2021, prioritizing frontline healthcare workers and individuals aged 40 years and above. Distribution has been concentrated in tertiary healthcare centers located mainly in urban areas, while much of the population in the southern region lives in rural and semi-urban settings with limited access to health services. Sebha, the capital of southern Libya, is a suburban city approximately 750 km from Tripoli and serves as the main hub for the surrounding rural communities. Given these geographic and structural challenges, understanding the perceptions, attitudes, and willingness of residents in southern Libya to receive COVID-19 vaccines is essential. Although a growing body of literature has examined vaccine hesitancy in several developing countries, there is still a lack of sufficient research on COVID-19 vaccine acceptance in Libya. Addressing this gap is critical for guiding vaccination strategies and public health interventions. Therefore, the present study aims to assess the perceptions and attitudes of the general population in southern Libya toward the emerging coronavirus vaccines, with particular attention to their willingness to be vaccinated.

Materials and methods

Study design and setting: This was a cross-sectional study conducted among adults in the southwestern region of Libya, encompassing urban and rural communities. The urban area was represented by Sebha city, while the rural areas included Um al-Araneb, Himmaira, Mesqueen, Traghen, Alghreefa, Ashkeda, Alzighn, and Alghatron. The study was carried out from January 2021 to December 2022.

Study population and participants: The study targeted the general population aged 18 years and above. Adults who were able to provide informed consent were eligible to participate. For participants who were unable to read or write, trained researchers administered the questionnaire verbally, explained the study consent details, obtained verbal informed consent, and recorded their responses accordingly.

Data collection tool: Data were collected using a structured, self-administered questionnaire (Appendix 1). The instrument was developed following expert group discussions and informed by previously published studies [12-14, 16-18]. The questionnaire was originally prepared in English and subsequently translated into Arabic to ensure cultural and linguistic appropriateness.

The questionnaire consisted of several sections: **Socio-demographic characteristics:** age, gender, marital status, educational status, employment, income, and place of residence (urban or rural). **Vaccine-related perceptions and attitudes:** participants were asked about their willingness to receive a COVID-19 vaccine if available, sources of information regarding COVID-19 and vaccines, and reasons for acceptance or refusal. **Opinions about COVID-19 vaccination:** nine items assessed general opinions about vaccination against COVID-19, including perceived

need for vaccination across different societal groups. Coding: 1=Agree, 2=Neutral, 3=Disagree, 4=No answer.

Data collection procedure: Participation in the survey was voluntary and anonymous. Each questionnaire was accompanied by a cover letter explaining the study objectives. Researchers provided participants with verbal and written explanations of the study. Individuals who agreed to participate completed the questionnaire at their convenience and returned it to the principal investigator for collection. Completed questionnaires were sealed and not reviewed until the end of the data collection period.

Sample size: The minimum required sample was calculated using the formula: $n = Z^2 \times p(1-p) / d^2$, where $Z = 1.96$ (95% confidence), $p = 0.5$ (assumed vaccine willingness, no prior data), and $d = 0.05$ (margin of error). This yielded 384 participants. To account for non-response, 785 questionnaires were distributed. The achieved sample of 689 respondents (87.8%) exceeded the minimum, ensuring adequate statistical power.

Ethical considerations: This study was conducted in strict accordance with the ethical principles outlined in the Declaration of Helsinki (Reference number: 022-MJ-0026). The study protocol, questionnaire design, and data collection procedures were reviewed, approved, and academically supervised by the Department of Pharmaceutical Care as part of the official pharmacy research curriculum at the Faculty of Pharmacy, Sebha University. Because this study utilized an anonymous, voluntary, questionnaire-based design with no clinical interventions, biological sampling, or collection of identifiable personal data, it met the institutional criteria for exemption from formal Institutional Review Board (IRB) alphanumeric registration. Before participation, all respondents were provided with a written cover letter detailing the study's objectives, guaranteeing absolute confidentiality, and explaining that completion and return of the questionnaire constituted informed consent. For participants with lower literacy levels who were unable to read or write, trained researchers read this information aloud, obtained verbal informed consent, and recorded their responses to ensure ethical compliance and inclusivity.

Data management and analysis: Survey responses were entered into Microsoft Excel 2010 and subsequently analyzed using the Statistical Package for the Social Sciences (SPSS), version 22. Descriptive statistics were applied to summarize participants' demographic characteristics and vaccine-related responses. Frequencies and percentages were used for categorical variables. Associations between socio-demographic factors and vaccine willingness were examined using the chi-square test. Statistical significance was set at $p < 0.05$.

For questions concerning reasons for accepting or refusing the COVID-19 vaccination, participants were allowed to select more than one response. Therefore, the number of reasons selected could exceed the number of participants in each willingness group. Frequencies in the multiple-response analysis represent the total number of selections rather than the number of unique participants.

Results

Socio-demographic characteristics and vaccine willingness: A total of 785 questionnaires were distributed, of which 689 were completed and returned, yielding a response rate of 87.8%, approximately 88.0%. **Table 1** shows the socio-demographic characteristics of the participants and their willingness to receive the COVID-19 vaccine. Overall, 445 participants (64.6%) were willing to receive the vaccine, while 35.4% were unwilling. Most participants were female (67.1%), unmarried (55.7%), living in rural areas or other villages (54.3%), and had university/high institute education (78.2%).

Regarding employment status, 53.6% participants were government employees, 13.1% worked in the private sector or were self-employed, and 33.1% were non-workers, while 45.1% reported an income of less than 1000 LD and 44.6% had no income.

Table 1: Acceptance versus refusal of COVID vaccination and relationship with social and demographic characteristics

Variable	Category	Total n (%)	Willing n (%)	Unwilling n (%)	p value
Age group	< 25	233 (33.8)	130 (55.8)	103 (44.2)	< 0.001
	25 - 35	177 (25.7)	116 (65.5)	61 (34.5)	
	36 - 50	184 (26.7)	122 (66.3)	62 (33.7)	
	51 - 65	77 (11.2)	60 (77.9)	17 (22.1)	
	> 65	17 (2.5)	16 (94.1)	01 (5.9)	
	Missing /uncoded	01 (0.1)	01 (100.0)	00 (0.0)	
Gender	Female	462 (67.1)	300 (64.9)	162 (35.1)	0.819
	Male	226 (32.8)	144 (63.7)	82 (36.3)	
	Missing/uncoded	01 (0.1)	01 (100.0)	00 (0.0)	
Marital status	Unmarried	384 (55.7)	232 (60.4)	152 (39.6)	0.014
	Married/previously married	304 (44.1)	212 (69.7)	92 (30.3)	
	Missing/uncoded	01 (0.1)	01 (100.0)	00 (0.0)	
Place of residence	Urban	312 (45.3)	185 (59.3)	127 (40.7)	0.008
	Rural/another village	374 (54.3)	259 (69.3)	115 (30.7)	
	Missing/uncoded	03 (0.4)	01 (33.3)	02 (66.7)	
Education level	Elementary / other low-level	55 (8.0)	43 (78.2)	12 (21.8)	0.027
	Secondary	70 (10.2)	46 (65.7)	24 (34.3)	
	University /high institute	539 (78.2)	338 (62.7)	201 (37.3)	
	Academic	12 (1.7)	11 (91.7)	1 (8.3)	
	Missing/uncoded	13 (1.9)	7 (53.8)	6 (46.2)	
Employment	Government	369 (53.6)	252 (68.3)	117 (31.7)	0.066
	Private sector /self-employed	90 (13.1)	51 (56.7)	39 (43.3)	
	Non-worker	228 (33.1)	141 (61.8)	87 (38.2)	
	Missing/ uncoded	02 (0.3)	01 (50.0)	01 (50.0)	
Income	< 1000 LD	311 (45.1)	210 (67.3)	102 (32.7)	0.268
	1000 - 2000 LD	59 (8.6)	38 (64.4)	21 (35.6)	
	> 2000 LD	11 (1.6)	09 (81.8)	2 (18.2)	
	No income	307 (44.6)	188 (61.2)	119 (38.8)	
Comorbidities	Yes	106 (15.4)	75 (70.8)	31 (29.2)	0.179
	No	582 (84.5)	369 (63.4)	213 (36.6)	
	Missing/uncoded	01 (0.1)	01 (100.0)	00 (0.0)	
Missing or uncoded responses were included in the table for completeness but were not interpreted as substantive categories. A p-value < 0.05 was considered statistically significant					

Vaccine willingness was significantly associated with age group ($p < 0.001$), marital status ($p = 0.014$), place of residence ($p = 0.008$), and education level ($p = 0.027$). Willingness generally increased with age, from 55.8% among participants aged < 25 years to 94.1% among those aged > 65 years. Married or previously married participants, rural residents, and some education groups showed higher willingness rates. No significant association was found between vaccine willingness and gender, employment status, income, or comorbidities.

In terms of education, 59.4% reported having a university degree, followed by high institute (19.6%) and secondary education (10.2%). Regarding employment, more than half (53.6%) were government employees. About one-third (33.1%) reported being unemployed, while 8.1% were self-employed and 4.6% worked in the private sector.

With respect to income, 45.1% reported earning less than 1000 Libyan dinars (LD) per month. 44.6% reported having no income. 10.0% of participants earned more than 1000 LD per month, of whom 8.4% earned 1000 - 2000 LD, and 1.6% earned more than 2000 LD.

Sources of information: As shown in **Table 2**, the most commonly reported source of information about COVID-19 and vaccination was the internet, reported by 58.2% of participants, followed by television among 25.4% of participants. Healthcare professionals were reported as a source by 7.7% of participants, while friends accounted for 5.7% of participants. Academic lessons were the least reported source for three participants (0.4%).

Table 2: Sources of information about COVID-19 vaccination among participants

Information sources	Frequency	Percent
No answer	4	0.6
Internet	401	58.2
Friends	39	5.7
Healthcare professionals	53	7.7
Television	175	25.4
Academic lessons	3	0.4
Other sources	14	2.0
Total	689	100.0

Reasons for acceptance and refusal of COVID-19 vaccination: **Table 3** presents the reasons for acceptance and refusal among participants who provided reasons. Among those who provided reasons for accepting vaccination, the most commonly reported reason was protection against COVID-19 infection (33.0%), followed by free vaccine availability (20.0%) and prevention of transmission to others (15.8%).

Table 3: Multiple-response analysis of reasons for acceptance and refusal of COVID-19 vaccination

Response group	Reason	Frequency	Percent
Reasons for acceptance	Protection against COVID-19 infection	137	33.0
	Vaccine provided free of charge	84	20.0
	Preventing transmission to others	66	15.8
	People around me have been vaccinated	41	9.8
	Returning to normal life	28	6.7
	Travelling abroad	25	5.9
	High risk of COVID-19 infection at work	19	4.6
	No need to take precautionary measures	17	4.1
	Total acceptance reasons	417	100.0
Reasons for refusal	Concern about vaccine safety and/or side effects	136	50.0
	Preferred to wait and observe vaccine effects in others	39	14.3
	Doubts about vaccine effectiveness	28	10.3
	General distrust of vaccines	27	9.9
	Belief in natural immunity	22	8.1
	Political concerns regarding vaccine development	18	6.6
	Belief that COVID-19 treatment was exaggerated	2	0.7
	Total refusal reasons	272	100.0

Participants were permitted to select more than one reason. Therefore, frequencies represent the number of reason selections rather than the number of unique participants. A total of 272 refusal-reason selections were recorded among 244 unwilling participants. Percentages were calculated using the total number of selections within the refusal group and therefore sum to 100%. Among the 445 willing participants, [number] provided at least one reason for acceptance, generating a total of 417 acceptance-reason selections.

Among the 244 participants who were unwilling to receive the COVID-19 vaccine, a total of 272 refusal-reason selections were recorded because participants were permitted to select more than one reason. Concern about vaccine safety and/or side effects was the most frequently selected reason, accounting for 136 of the 272 refusal-reason selections (50.0%). This was followed by preference to wait and observe vaccine effects in others, 39 selections (14.3%); doubts about vaccine effectiveness, 28 selections (10.3%); and general distrust of vaccines, 27 selections (9.9%).

Participants' opinions regarding COVID-19 vaccination: **Table 4** summarizes participants' opinions regarding COVID-19 vaccination. About half of the participants agreed that COVID-19 vaccination was important, 50.4%, and that everyone should receive the vaccine once available (50.9%). However, 37.3% supported mandatory vaccination. Nearly half of the participants, 48.9%, agreed that vaccination should be administered after government confirmation of its safety. Most participants acknowledged that COVID-19 was already present in Sebha and southern Libya, 70.7%. Opinions were more divided regarding the accuracy of government and media reports, with 25.4% agreeing, 32.7% neutral, and 28.6% disagreeing. Also, responses were nearly balanced on whether participants would wait to take the vaccine until required by law, with 36.4% agreeing and 36.7% disagreeing.

Table 4: Participants' opinions regarding COVID-19 vaccination

Participants' opinions	Agree n (%)	Neutral n (%)	Disagree n (%)	No answer n (%)	Total n (%)
Is COVID-19 vaccination important?	347 (50.4)	176 (25.5)	100 (14.5)	66 (9.6)	689 (100.0)
Should everyone get the vaccine as soon as it is available?	351 (50.9)	131 (19.0)	114 (16.5)	93 (13.5)	689 (100.0)
Should COVID-19 vaccination be mandatory?	257 (37.3)	126 (18.3)	205 (29.8)	101 (14.7)	689 (100.0)
Should vaccination be administered only after government confirmation of its safety?	337 (48.9)	157 (22.8)	103 (14.9)	92 (13.4)	689 (100.0)
If infected, am I at low risk of complications?	242 (35.1)	144 (20.9)	191 (27.7)	112 (16.3)	689 (100.0)
Are government and media reports on COVID-19 accurate?	175 (25.4)	225 (32.7)	197 (28.6)	92 (13.4)	689 (100.0)
Is COVID-19 already present in Sebha and southern Libya?	487 (70.7)	73 (10.6)	40 (5.8)	89 (12.9)	689 (100.0)
Are measures other than vaccination sufficient?	236 (34.3)	170 (24.7)	187 (27.1)	96 (13.9)	689 (100.0)
Will you wait to take the vaccine until required by law?	251 (36.4)	95 (13.8)	253 (36.7)	90 (13.1)	689 (100.0)

Priority groups for vaccination: **Table 5** shows participants' views on priority groups for COVID-19 vaccination. The largest proportion of participants believed that vaccination should be offered to all people, 41.2%, followed by the elderly, 17.6%, and people at risk of contracting the disease, 17.1%. A smaller proportion selected people with weak immune systems, 6.4%, or chronic comorbidities (5.5%), while 11.8% participants reported having no idea.

Table 5: Participants' opinions on priority groups for COVID-19 vaccination

Questions options	Frequency	Percent
All people	284	41.2
People who are at risk of contracting the disease	118	17.1
The elderly	121	17.6
People with chronic comorbidities	38	5.5
People with a weakened immune system	44	6.4
I have no idea	81	11.8
Other people	3	0.4
Total	689	100.0

Discussion

Vaccine acceptance is an important determinant of the success of immunization programs, particularly during public health emergencies. Although vaccines are among the most effective public health interventions for reducing infectious disease morbidity and mortality, their impact depends not only on availability but also on public willingness to receive them [3, 4, 7]. Therefore, assessing attitudes toward COVID-19 vaccination in southern Libya is important, especially because evidence from this region remains limited. In the present study, 689 completed questionnaires were returned from 785 distributed questionnaires, yielding a response rate of approximately 88.0%. Overall, 64.6% of the participants were willing to receive the COVID-19 vaccine, while 35.4% were unwilling. This level of willingness is moderate compared with international studies. It is lower than the acceptance reported in China, where willingness reached 91.3% [17], and slightly lower than that reported in Japan at 65.7% [11]. However, it falls within the wide global range reported in a systematic review, where COVID-19 vaccine willingness ranged from 27.7% to 91.3% across different populations [16]. Such variation may be explained by differences in study timing, vaccine availability, perceived disease severity, trust in authorities, and exposure to misinformation [12, 16, 21].

Vaccine willingness was significantly associated with age, marital status, place of residence, and education level. Willingness increased with age, with the highest acceptance among participants older than 65 years. This finding is consistent with previous studies showing that younger adults are often more hesitant toward COVID-19 vaccination [23, 24]. Older participants may perceive themselves as more vulnerable to severe COVID-19 outcomes, which can increase vaccine acceptance. Disparity, gender, employment status, income, and comorbidities were not associated with vaccine willingness in this study. Although some studies have reported higher hesitancy among women [24], this association was not observed in our sample, suggesting that determinants of vaccine acceptance may vary by social and geographic context. The internet was the most commonly reported source of information about COVID-19 vaccination, followed by television, while a small proportion relied on healthcare professionals. This finding is important because social media and online platforms have been widely associated with the spread of anti-vaccination messages and misinformation, which may increase fear and mistrust [20, 26]. Similar concerns were reported in previous studies, where misinformation and uncertainty about vaccine safety contributed to hesitancy [12, 21, 22]. The limited role of healthcare professionals as a source of information highlights the need to strengthen direct communication between health workers and the community. The main reasons for accepting vaccination were protection against COVID-19 infection, free vaccine availability, and prevention of transmission to others. These findings are consistent with the Health Belief Model, which suggests that vaccine uptake is influenced by perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action [27]. Similar motivations have been reported in other studies, where perceived benefits and perceived risk of infection were associated with greater willingness to receive COVID-19 vaccines [12, 16, 17]. Concern about vaccine safety and/or side effects was the most frequently reported reason for refusal [28, 29]. Other reasons included preferring to wait and observe vaccine effects in others, doubts about vaccine effectiveness, and general distrust of vaccines. These barriers are consistent with the WHO SAGE framework, which describes vaccine hesitancy as a complex phenomenon influenced by contextual, individual, group, and vaccine-specific factors [21]. Safety concerns and mistrust have been identified as major barriers in COVID-19 vaccine acceptance studies [12, 22, 24, 26, 30, 31]. Participants' opinions reflected mixed attitudes toward vaccination. Nearly half agreed that COVID-19 vaccination was important and that everyone should receive the vaccine once available, while one-third supported mandatory vaccination. Although most participants recognised the presence of COVID-19 in Sebha and southern Libya, uncertainty remained regarding official information and vaccine safety. This pattern suggests that awareness of the disease does not necessarily translate into full confidence in vaccination, particularly when trust in health information is limited [21, 22, 26].

This study is among the few to examine COVID-19 vaccine willingness and barriers in southern Libya. The findings highlight the critical need for targeted health education campaigns that address safety concerns, correct misinformation, and improve trust in vaccination programs, with greater involvement of healthcare professionals, community leaders, and reliable media. Crucially, the barriers identified-safety concerns, vaccine distrust, and misinformation-extend beyond COVID-19 and are likely to affect uptake of routine childhood immunizations, influenza vaccines, and future pandemic vaccines. Libya's fragmented health system, exacerbated by conflict and limited rural healthcare access, has created a fragile environment where vaccine confidence is easily undermined. Therefore, the strategies developed to improve COVID-19 vaccine acceptance must be integrated into a broader, long-term national immunization plan. Such an approach would not only address the current pandemic but also build resilience against future vaccine-preventable outbreaks and improve overall population health in Libya.

This study has several limitations. First, data were collected using self-administered questionnaires, which may be subject to recall bias and socially desirable responses. Second, although the study included participants from urban and rural areas, it was limited to southern Libya and may not fully represent the views of the entire Libyan population. Third, the cross-sectional design does not allow for the establishment of causal relationships between socio-demographic factors and vaccine willingness. An additional limitation is the relatively long data collection period, extending from January 2021 to December 2022. During this period, public perceptions of COVID-19 vaccination may have changed due to changes in vaccine availability, government policies, pandemic severity, media coverage, and misinformation. Since the exact date or month of questionnaire completion was not recorded for each participant, it was not possible to analyze vaccine willingness across different time periods or present a time-trend analysis. Finally, the study relied on self-reported sources of information, such as the internet and television, which may not fully reflect the complexity of media influence on vaccine hesitancy. Future studies should consider using shorter data collection periods or recording the timing of responses to allow temporal analysis of vaccine acceptance. Longitudinal and qualitative studies are also recommended to understand changes in attitudes over time better and explore cultural, social, and political factors influencing vaccine hesitancy in Libya. Expanding similar studies to other Libyan regions would also improve comparability and generalizability.

Conclusion: This study highlights that while a substantial proportion of the population in southern Libya expressed willingness to receive a COVID-19 vaccine, the overall acceptance rate remains below the level required to achieve community-wide protection against the pandemic. Vaccine hesitancy was strongly influenced by socio-demographic characteristics as well as by perceptions of vaccine safety and trust in official information sources. The internet emerged as the primary source of information, but the prevalence of misinformation online may have contributed to doubts and resistance among participants. These findings underscore the urgent need for targeted public health strategies, including community-based awareness campaigns and greater involvement of healthcare professionals to improve vaccine confidence and uptake among adults. Critically, the barriers identified-safety concerns, general vaccine distrust, and misinformation exposure-are not confined to COVID-19 and are likely to impede uptake of routine childhood immunizations, influenza vaccines, and future pandemic vaccines across the country. Libya's fragile health system, compounded by conflict and limited rural healthcare access, has created an environment where vaccine confidence is easily eroded.

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